

CLAIMS

1. A method for manufacturing semiconductor device, comprising:

5       a first film forming step of forming, on a concave and convex portion formed by an element on a semiconductor substrate, an oxidation preventive layer which prevents permeation of moisture into the element;

10       a second film forming step of forming, on the oxidation preventive layer, an expansion layer which can be oxidized and expanded by a heat treatment in an oxidation atmosphere;

15       a third film forming step of forming, on the expansion layer, an insulating film which can be fluidized by the heat treatment in the oxidation atmosphere; and

20       an expansion step of subjecting, to the heat treatment in the oxidation atmosphere, the semiconductor substrate on which the oxidation preventive layer, the expansion layer and the insulating film have been formed, to fluidize the insulating film and to oxidize and expand the expansion layer, thereby eliminating bubbles generated in the insulating film.

25       2. The method for manufacturing semiconductor device according to claim 1, wherein the expansion layer is made of a polycrystalline silicon, an amorphous silicon or a silicide.

3. The method for manufacturing semiconductor device according to claim 1, wherein the expansion layer is made of aluminum, tantalum or an alloy of them.

5

4. The method for manufacturing semiconductor device according to claim 1, wherein the insulating film is a silicon oxide film containing at least one of phosphorus, arsenic, boron, fluorine and a halide.

10

5. The method for manufacturing semiconductor device according to claim 1, wherein the oxidation preventive layer is formed of a silicon nitride film.

15

6. The method for manufacturing semiconductor device according to claim 1, wherein a pressure of the oxidation atmosphere in the expansion step is atmospheric pressure or more, and a temperature of the heat treatment is 400°C to 800°C.

20

7. A method for manufacturing semiconductor device, comprising:

a first film forming step of forming, on a concave and convex portion formed by an element on a semiconductor substrate, an oxidation preventive layer which prevents permeation of moisture into the element;

25

a second film forming step of forming, on the

oxidation preventive layer, an expansion flow layer which can be oxidized, expanded and fluidized by a heat treatment in an oxidation atmosphere and which has an insulating property; and

5           an expansion step of subjecting, to the heat treatment in the oxidation atmosphere, the semiconductor substrate on which the oxidation preventive layer and the expansion flow layer have been formed, to oxidize, expand and fluidize the expansion flow layer, thereby eliminating  
10 bubbles or open pores generated in the expansion flow layer.

8. The method for manufacturing semiconductor device according to claim 7, wherein the expansion flow layer is made of a polycrystalline silicon or an amorphous  
15 silicon containing at least one of boron, phosphorus and fluorine.

9. The method for manufacturing semiconductor device according to claim 7, wherein the oxidation  
20 preventive layer is formed of a silicon nitride film.

10. The method for manufacturing semiconductor device according to claim 7, wherein a pressure of the oxidation atmosphere in the expansion step is atmospheric  
25 pressure or more, and a heat treatment temperature is 400°C to 800°C.